Japan Land Prices: A Statistical Expectations Modeling Approach*

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Abstract

This paper creates a set of multivariate statistical regressions models for testing the consistency of observed Japanese land market prices with present value market fundamentals. In contrast to earlier studies, our statistical results imply that the long run behavior of land prices is consistent with the present value model. We attribute this difference to both our use of expectational data and the reformulation of the statistical procedures for testing the present value model.

The fundamental paradigm of financial economics is the current market value of an asset is the expected risk adjusted present value of its future cash flows. The objective of the paper is to develop and test a statistical framework in order to determine empirically if Japanese land prices are consistent with the present value model. The Japanese land market has experienced extraordinary volatility and "regime" shifts for more than two decades. In the 1980's, the land market was blessed with nothing short of an astronomical upward trend in values. In less than ten years, for example, commercial real estate values increased by a factor of about five times. Long before the peak was achieved, many dubbed the increases in Japanese land market prices as a bubble. Starting in about 1990, a diametrically opposed, unanticipated by many, volatile, precipitous, and secular decline in land prices emerged. Can the simple present value model "explain" the roller-coaster Japanese land prices phenomenon? In brief, we find that Japanese land prices do not deviate systematically from present value model market fundamentals.

Our presentation is organized into seven subsequent sections. Section I discusses difficulties with standard regression tests of the present value model. Sections II and III outline an improved statistical methodology. Section IV describes the data base. Section V develops the expected land price forecasting model. In Section VI, we estimate the present value statistical model and interpret the empirical results. The last section contains the summary.

I. Unearthing Statistical Problems

The present value model is

$$P_t = \sum_{i=1}^{\infty} \frac{E_t R_{t+i}}{(1+k)^i} \tag{1}$$

Where P_t is the land price at the *end* of period *t*, R_{t+i} is the land rent *during* period $t + i$, k is the appropriate risk-adjusted discount rate, which is assumed to be constant, and E_t is the investor's expectations operator conditional upon information available at time *t*.

Following LeRoy and Porter (1981) and Shiller (1981), we define the *ex post* rational land price or the market fundamental as

$$P_t^* = \sum_{i=1}^{\infty} \frac{R_{t+i}}{(1+k)^i} \tag{2}$$

Since $E_t P_t^* = P_t$, we have

$$P_t^* = P_t + \eta_t \tag{3}$$

Where η_t is a rational forecast error that is uncorrelated with P_t. It follows that var(P_t^*) $\geq$ var(P_t). The econometric issues associated with the variance bounds test have been a subject of heated debate among researchers.[1]

From this controversy, Scott (1985), among others, suggests that applying ordinary least squares (OLS) estimation to equation (3) provides a test of the present value model.[2] However, because of two interrelated problems, we believe, equation (3) cannot be utilized directly to test whether land prices follow the present value model. First, by the definition of P_t^*, we have

$$P_t^* = \frac{P_{t+1}^* + R_{t+1}}{1+k} \tag{4}$$

We rewrite the present value model as[3]

$$P_t = \frac{E_t\left(P_{t+1} + R_{t+1}\right)}{1+k} \tag{5}$$

Let $P_{t+1} + R_{t+1} = E_t\left(P_{t+1} + R_{t+1}\right) + \mu_{t+1}$, where μ_t is, by definition, a rational forecast

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[1] See Gilles and LeRoy (1991) for a survey of the literature on the variance bounds test.
[2] Scott (1990), applying his model, finds that United States land valuation in the central states is not consistent with the present value model.
[3] Since we will develop a bubble-free test of the present value model, we do not consider rational bubbles, as discussed by Flood and Garber (1980) and Froot and Obstfeld (1991).

error that is *serially uncorrelated*. Equation (5) becomes

$$P_t = \frac{P_{t+1} + R_{t+1} - \mu_{t+1}}{1+k} \tag{6}$$

Subtracting equation (6) from equation (4) yields

$$\eta_t = \frac{\eta_{t+1} + \mu_{t+1}}{1+k} \tag{7}$$

$$= \sum_{i=1}^{\infty} \frac{\mu_{t+i}}{(1+k)^i}$$

Where $\operatorname{cov}(\eta_{t+1}, \mu_{t+1}) = 0$ because rational μ_t are uncorrelated over time. The rational forecast error η_t is "forward looking," and represents the present value of future forecast errors, μ_{t+1} for $i = 1, \cdots, \infty$.

Since P_t^* is not observed, it is usual to subsume that the observed market price at the end of the sample period, P_T, is the same as P_T^*. The estimated market fundamental is $\hat{P}_t^*$ is obtained in the following way:

$$\hat{P}_T^* = P_T = P_T^* - \eta_T$$

$$\hat{P}_{T-1}^* = \frac{\hat{P}_T^* + R_T}{1+k} = P_{T-1}^* - \frac{\eta_T}{1+k}$$

$$\hat{P}_t^* = \frac{\hat{P}_{t+1}^* + R_{t+1}}{1+k} = P_T^* - \frac{\eta_T}{(1+k)^{T-t}} \tag{8}$$

It follows that

$$\hat{P}_t^* = P_t + \eta_t - \frac{\eta_T}{(1+k)^{T-t}}$$

$$= P_t + \frac{\mu_{t+1}}{1+k} + \cdots + \frac{\mu_T}{(1+k)^{T-t}}$$

$$= P_t + \hat{\eta}_t. \tag{9}$$

The auto-covariance structure of $\hat{\eta}_t$ in equation (9) is not the same as that of η_t in equation (3), the true model. This happens because $\hat{\eta}_t = 0$ by construction. Given T observations, if μ_t is i.i.d. over time, it can be seen that

$$\mathrm{cov}(\hat{\eta}_i, \hat{\eta}_j) = \frac{\sigma_\mu^2 \alpha^2 \left(\alpha^{2(\max(i,j))} - \alpha^{2T}\right)\alpha^{-(i+j)}}{1-\alpha^2} \text{ for } i,\ j = 1, \cdots, T-1 \tag{10}$$

Where σ_μ^2 is the variance of μ_t and $\alpha = 1/(1+k)$. It follows that

$\mathrm{cov}(\hat{\eta}_{t+i}, \hat{\eta}_{t+j}) \neq \mathrm{cov}(\hat{\eta}_{s+i}, \hat{\eta}_{s+j})$ for $t \neq s$; in particular,

$\sigma^2(\hat{\eta}_t) > \sigma^2(\hat{\eta}_{t+i})$ for $i \geq 1$. Hence statistics for the estimated regression coefficients of equation (9) need to be adjusted for autocovariances of the residuals as described in (10).

The second empirical problem with the estimation of equation (9) relates to Japanese land price data. Japanese land values, as reported by the Bank of Japan, are averages collected through surveys. The data construction procedures are likely to cause the estimated μ_t to be a moving average (MA) process (i.e., autocorrelated).

II. A Plot for the Statistical Method

The autocorrelation of $\hat{\eta}_t$ is created by forecast rationality (see equation 10) and/or by the data collection procedure. We cannot distinguish empirically between these two causes. For this reason, we develop an alternative test for the present value model for land prices. Starting with equation (8), we have

$$\hat{P}_t^* - P_t = P_t^* - P_t - \frac{\eta_T}{(1+k)^{T-t}} \tag{11}$$

By substituting the right hand side of equations (4) and (6) for P_t^* and P_t , respectively, in the right hand side of equation (11), we obtain

$$\hat{P}_t^* - P_t = \frac{P_{t+1}^* - P_{t+1}}{1+k} + \frac{\mu_{t+1}}{1+k} - \frac{\eta_T}{(1+k)^{T-t}} \tag{12}$$

Substituting $\hat{P}_{t+1}^* + \frac{1}{(1+k)^{T-(t+1)}}\eta_T$ for P_{t+1}^* in equation (12) yields

$$\hat{P}_t^* - P_t = \frac{\hat{P}_{t+1}^* - P_{t+1}}{1+k} + \frac{\mu_{t+1}}{1+k} \tag{13}$$

Equations (9) and (13) are theoretically equivalent statements of the present value model. However, the estimation of equation (13) offers at least three distinct statistical advantages as compared to equation (9). First, if the forecast error μ_{t+1} is serially uncorrelated, since $\hat{\eta}_{t+1} = \hat{P}^*_{t+1} - P_{t-1} = \sum_{i=1}^{T-(t+1)} \mu_{t+1+i} / (1+k)^{i-1}$, then μ_{t+1} is uncorrelated with $\hat{P}^*_{t+1} - P_{t+1}$. Thus, estimating equation (13) using OLS is straightforward.

Second, if the estimated μ_t is serially correlated because of the Japanese land price data collection procedure, we can estimate equation (13) by applying generalized least squares (GLS).

Third, since $(1+k)\hat{P}^*_t - \hat{P}^*_{t+1} = R_{t+1}$ the GLS correction for the first order autocorrelation of $\hat{\eta}_t$ in equation (9) generates $R_{t+1} = (1+k)P_t - P_{t+1} + \mu_{t+1}$ Rearranging this equation replicates Chow's (1989) regression equation for testing the present value model:

$$P_{t+1} = (1+k)P_t - R_{t+1} + \mu_{t+1} \tag{14}$$

Since R_{t+1} affects P_{t+1}, μ_{t+1} is likely to be correlated with R_{t+1} engendering a simultaneity bias in equation (14). The simultaneity bias can be resolved *apparently* by using instrumental variables (IV); this estimation method requires that the forecast error μ_{t+1} be uncorrelated with the instrumental variables, i.e., the lagged variables which are used to predict the rent R_{t+1}. If for any reason this condition is not satisfied, estimation of equation (14) may cause false rejection of the present value model.[4]

[4] If the residuals from equation (14) are serially correlated because of the land data collection procedure, the presence of the lagged dependent variable as an explanatory variable causes the estimated coefficients of equation (14) to be biased. For this reason, we do not necessarily accept the finding of Tegene and Kuchler (1991) that US farm value/rent data do not support equation (14)

In summary, equations (9), (13) and (14) are theoretically equivalent statements of the present value model.[5] Estimation of equation (13) corrects for serial correlation of $\hat{\eta}_t$ in equation (9) and avoids the simultaneity bias in the estimation of equation (14)

III. Developing Empirical Results

Preliminary statistical analysis of equation (13) indicated that $\sigma^2(\mu_{t+1})$ is proportional to P_t^2. In order to control for heteroskedasticity of μ_{t+1} we reformulate equation (13) as

$$\frac{\hat{P}_t^* - P_t}{P_t} = b_0 + b_1\left(\frac{\hat{P}_{t+1}^* - P_{t+1}}{P_t}\right) + e_{t+1} \tag{15}$$

Where $e_{t+1} = \mu_{t+1}/((1+k)P_t)$, and the null hypotheses are

$b_0 = 0$ and/or $b_1 = 1/(1+k)$.

Equation (15) in a slightly modified form is the ultimate equation we use to estimate land values for Japan. In order to accomplish this goal, we shall discuss our data base and the utilization of an intermediate model for estimating (i.e., forecasting) expected land price fundamental $(\hat{P}_t^*)$.

IV. Data Messuage

Our data base, derived from the Bank of Japan, the Tankan Surveys, standard macro-economic variables and official Japan land prices for 1982 through 2006, is available

[5] Dokko (1991) shows how equation (13) holds irrespective of the existence of rational bubbles in land values, as considered by Flood and Garber (1980) and Froot and Obstfeld (1991).

from public and quasi-public sources. In broad brush terms, our data base consists of land prices, expectational surveys variables, and standard macro-economic performance variables.

Land Prices

It is important to understand the realm of Japanese land prices. Appendix B contains the annual mean nominal rate of return for Japanese commercial land. Rates of return for Japanese commercial land are highly volatile over time. What happened to Japan's land markets between 1982 and 2006? Figure 1 displays price information for the Japanese real estate market from 1982 through 2006. Using indices for commercial and residential land for the six largest cities of Japan and GDP, we can identify the so-called bubble economy for the land markets. The commercial land index peaks in 1989-90 with a level of almost five times that of the 1983 index value. By 2001, the nominal value of the index retreats to below its 1983 level; and in *real* terms, the 2001 commercial real estate land index is substantially lower than the 1983 real value, and has remained in nominal terms at the 2001 level through 2006. During this time period, the residential land index, while never achieving the same heights as the commercial land index, peaks at approximately the same time at a value of over three times the 1983 index value, and recedes by 2001 to its 1983 level where it has remained through 2006. In *real* terms, the 2001 through 2006 residential land index remains below the level of 1983. In the early 1980s, land price indices for Tokyo and other area commercial and residential land increased faster than general economic activity (i.e., the Tokyo and total GDP Index), and subsequently these land indices have declined relative to GDP activity. Ziemba (1992) demonstrates that the ratios of real estate land values to GDP had been relatively constant between 1960 and 1980. However, commencing in the early 1980's the Japanese land price – GDP relationship has become much more volatile.

Figure 1 may not convey fully how extensively Japanese real estate markets have declined from the boom to bust. Land supply, especially urban land, prior to the 1990's had been considered to be fixed and limited. This assumption may no longer be true. For commercial real estate in Tokyo, the Ministry of Transport, among other government and quasi-governmental entities, has made available substantial amounts of land for development. On the residential side, the Ministry of Finance, the Tokyo Metropolitan Government, and the Ministry of Agriculture have released farm and other lands in metropolitan areas for residential development. In brief, large amounts of formerly unavailable land unexpectedly have been made available for commercial and residential projects. In sum, since 1990, demand for real estate probably has been waning (with perhaps an uptick since 2002 or so), and the supply of available potential land for commercial and residential use has increased. This is a simple set of economic circumstances which would be expected to lead to real estate price declines.

Expectations Data

We employ three especially rich, well-maintained expectational data sets to explain Japanese land prices. The data sets are the Tankan Survey, the Consumer Confidence Index, and interest rates.

Tankan Survey

The Bank of Japan conducts a quarterly survey of companies (the Tankan), widely regarded as the best survey of its kind in the OECD. The quarterly survey results provide two sets of information: business sentiments (expectations) and actual business performance, such as production, sales, and business fixed investments. We use data from the "Short-Term Economic Survey of All Enterprises," a survey for a large sample of companies. Respondents are required to answer sentiment (i.e., expectations) questions by describing circumstances as either "favorable," "not so favorable," or "unfavorable." The Bank of Japan is a diligent surveyor, with multiple levels of follow-up. This proactive surveyor approach maintains the quality of the Tankan data. We utilize in our statistical model the Tankan Survey data for expectations for the five "core" questions.

The Tankan Survey data range from a theoretical maximum of plus one hundred to a minimum of minus one hundred. The correlations between the different Tankan Survey variables range from more than 0.9 to virtually zero. Hence, the Tankan variables appear to measure several different types of expectations.

Confidence Index

Since 1982 the Bank of Japan has published a consumer confidence index.

Interest Rates

The differential between the long-term and the short-term interest rates is a measure of the financial market expectations of inflation and the phase of the business cycle. We employ the differential between the long-term interest rate (ten years) and short-term (three months) interest rate in order to measure these expectations. The short-term interest rate is the three-month Gensaki rate, or repo rate, for certificates of deposit. The long-term rate is an average yield for eight-to-ten year government bonds.

Macro Data

In this study, a set of macro-economic and macro-finance variables are utilized. In general, we treat these data as exogenous. Thus, we can employ these "exogenous" variables as instruments in our instrumental variable statistical regression analysis. The set of macro data instrumental variables available from DataStream are the following:

Name	Description
Jpispbmna	Municipal Bonds
Jpispubba	Consolidated Public Defecit
Jpocm2mnb	M2+ (includes certificates of deposit)
Nikkei	Stock Index
Jpexptcmb	Exports
Jpgnpd	GNP
Jpbonds	Government Bonds
Jpimptcmb	Imports
Jpisgvtga	Government Guaranteed Bonds
Govcon	Government Consumption Expenditure
Percon	Personal Consumption Expenditure
Fixcapform	Gross Fixed Capital Formation

V. The Plot For Forecasting Expected Land Prices

Using Expectations to Model Expected Land Prices

Role of Expectations **-** All asset prices, including land prices, are determined by expectations about the future. Price formation is forward-looking, especially for long-lived assets such as land. By using expectations survey data in conjunction with interest rates (which are an intertemporal expectational price), we generate estimates and forecasts for land asset prices. Our basic view is that fundamental socio-economic variables are influenced by expectations. Japanese land prices are determined by numerous, complex, and interactive relationships between and among socio-economic variables. Potentially important variables such as land tax policy may be difficult to quantify per se. Rather than trying to identify all the complex interactive effects of fundamental variables, and model a concatenation of intricate mathematical relationships, we have developed a simple model using expectations data. These expectations are utilized by economic entities to determine economic decisions, which, in turn, create economic market outcomes, one of which would be the price of land.

The Statistical Model for Forecasting Expected Land Prices

Using this approach for expectational data, we develop a statistical forecasting model for big cities commercial land prices. The general form for our model is:

Change in the Land Price Index = $\sum \beta_i X_i + \varepsilon$

(16)

Where β_i is the vector of estimated coefficients for vector X_i; X_i is the vector of predictor variables; and ε is the stochastic error term.

The independent expectation variables may be in log form and are lagged (except for the interest rate spread) because expectations are forward-looking one quarter. In general, X_i is derived from the Tankan expectations survey data.

The final form of the equation we utilize for our statistical land price forecasting model is:

(Change in real estate price index)$_{t,\, t\text{-}1} = c + \beta_1$ (corporate expectations about its liquidity)$_{t-1} + \beta_2$ (corporate expectations of loan credit availability) $_{t-1} + \beta_3$ (differential of long minus short interest rates). c is the regression estimated constant.

Statistical Results for Expected Land Prices

The results of our statistical model for the big cities commercial land market, estimated using OLS, are presented in Table 1A and Figure 2. Table 1A contains the parameter estimates for the multivariate regression model for forecasting the land price fundamental. Figure 2 plots the fitted, actual and residuals for the Table 1A statistical model.

The statistical findings are consistent with our earlier work (see Edelstein and Paul (2000)), and indicate that both short-run expectational variables (i.e., perceived credit availability and corporate liquidity) as well as longer term expectational variables (i.e., the bond interest rate spread) are important statistically significant determinants for forcasting Japanese commercial land prices.[6] Because in 1990-1991, there is a sharp break in the land prices time series, we test the normality of the regression residuals. Statistical tests on the residuals indicate that they are normally distributed; and, the best fitting business expectations variables are the level of expected corporate cash and

[6] Standard statistical tests indicate that the data are co-integrated. This should not be surprising because three of the variables utilized in the analysis are "changes" or "deltas", such as land price changes, change in consumer confidence index and interest rate spread differential. Also, the two Tankan survey data variables are provided in the form of a diffusion index, which is a "differential" form. Hence, even if the "level" were not co-integrated, the lagged differential variables are likely to be stationary.

corporate perceived willingness of banks to lend.[7] These variables collectively provide strong support for the "credit crunch" hypothesis; credit availability, or, conversely, rationing, appears to affect real estate prices in Japan. Furthermore, we find statistical evidence that one or more structural changes in the Japanese land market probably occurred between 1988 and 1991, a result consistent with earlier studies.[8] (The Analysis suggests that a structural change may also have occurred in the 2002-2004 time period.) Importantly, our model (Equation 16), using expectations data, has the ability to account for these structural changes.[9]

[7] The consumer confidence index does not appear to be an important predictor variable for commercial land prices, but is important for residential land prices. (Results not reported in the paper.)

[8] Fisher-Chow tests indicate structural breaks in the land price data and economy of Japan between 1988 and 1991; See Edelstein and Paul (1997) and Edelstein and Paul (2000) for further discussion. See, also, Kallberg, et.al., (2002) for analysis of regime shifts in other Asian markets, caused by the 1997 financial crisis.

[9] Since we are concerned with the statistical capacity of forecasting land price model, we only note that the data is autocorrelated, and adding the lagged dependent variable does not improve the fit remarkably.

It is important to examine the lead/lag relationships among real estate land prices and other alleged independent variables. Granger-Sims causality tests can measure the predictive power withint the data set. For example, loan credit availability "Granger-Sims causes" land price changes if, after controlling for the past history of land price changes, credit availability is a statistically significant explanatory variable of the residual (i.e., unexplained variability) of land price changes.

In Table 2, Granger-Sims statistical causality tests are employed to examine the causal relationships among the predictor variables and changes in Japanese land prices. The tests, using autoregressive lags of one period, indicate that the interest rate spread and loan credit availability variables cause Japanese land price changes. However, the causality tests suggest that Japanese land price changes simultaneously cause interest rate spreads and corporate liquidity. Both of these latter causal relationships are plausible given the importance of Japanese land market and its inter-connectedness to the Japanese business economy, and are consistent with earlier studies. [10] Collectively, these causality tests signify a potential "simultaneity" bias for our statistical model, equation 16, and statistical results contained in Table 1A.[11]

To address the possibility of simultaneity among variables used in Table 1A, (equation 16), the land price forecasting model has been re-estimated, employing an instrumental variables technique. The statistical results, using the instrumental variable approach, are

[10] See, for example Ziemba (1992) and Edelstein and Paul (2000)

[11] The findings of "reverse" causality suggests strongly that there is a set of common factors affecting real estate land price changes and some of our "independent" variables. Put somewhat differently, it is possible that our simple Granger-Sims relationships are mis-specified, missing a common explanatory variable for some of our time series data sets.

reported in Table 3A.Qualitatively, the statistical findings in Table 3A are similar to those reported in Table 1A (using OLS). The overall fit is about the same, with an $R^2 = .52$ (versus .51); and the loan credit availability and corporate liquidity variable coefficient are statistically significant at the five percent level.

VI. Harvesting Empirical Evidence

Table 1B presents the statistical findings for equation 15, the present value model, utilizing Table 1A land price forecasts. To create both the left hand side and right hand side variables, we extract the "forecast" for Japanese land prices derived from equation 16, Table 1A. We test the joint hypotheses for the estimated coefficients: $\hat{b}_o = 0$ and $\hat{b}_1 = (1+k)^{-1}$, where k is the mean annual discount rate. Our findings indicate that we cannot reject the null hypothesis for the present value model. The implied discount rate for Japanese real estate investment in the 1980's and 1990's estimated from $\hat{b}_1$ in Table 1B is about 8% and $\hat{b}_o$ is statistically not different from zero.

Table 3B represents the statistical findings for equation 15, utilizing statistical output from Table 3A to generate land price forecasts (analogous to the tandem analysis for Tables 1A and 1B). The estimated coefficient values from Table 3B, which employs land forecasts based upon the instrumental variable estimation in Table 3A, translate into estimated long run average discount rates for Japanese Real Estate investment for the 1980's and 1990's of about 5%. Also, the estimate of the constant coefficient in equation 15 for Table 3B is <u>not</u> statistically different from zero.

Our collective statistical results imply that the present value model may well describe the long run behavior of Japanese commercial land prices. Also, the results imply that long run average discount rates for Japanese real estate investment for the 1980's, 1990's, and through the mid-2000's, are about 6 to 7%, and substantially higher than interest rates on "risk free" Japanese treasury bonds and Japanese corporate bonds. This discount rate is consistent with the notion that real estate is a risky investment, and what one would reasonably estimate for the Japanese economy.

VII. Sowing the Seeds for Future Research

Our statistical findings indicate that Japanese land valuation is consistent with the present value model. This contrasts with earlier findings for Japanese and other land markets. We attribute this difference to both our use of expectational data and the reformulation of the statistical procedures for testing the present value model.

Future research might focus on the development of explicit structural models for the long run general equilibrium of the land market. In such a framework, land valuation would be derived from the supply and demand relationships for real estate products. Structural models would permit the analysis of the impacts of important variables relating to real estate user and supplier behavior. These variables might include public policy variables (e.g., monetary-fiscal policy, and governmental land policy) and exogenous economic variables (e.g.; currency exchange rates and general economic activity).

Table 1A: OLS Statistical Regression for Expected Land Price Forecast Model (Equation 16), 1982-2004

Dependent Variable $D(\text{Six Com})$, Change in Large City Commercial Land Prices

Variable	Coefficient*	t-statistic*
Constant	5.72	2.38
Interest Rate Spread, lagged $(\text{Bond Yield} - \text{Gen}(-1))$	-1.66	-1.24
Corporate Liquidity, lagged $(\text{Liquidity}(-1))$	0.63	2.93
Loan Availability, lagged $(\text{Loan}(-1))$	0.24	2.44

$R^2 = 0.52$

F-static = 31.07

Durbin-Watson Statistic = 0.23

*White Hetroskedasticity-consistent variance and co-variance matrix

Table 1B: Present Value Model Statistical Results (Equation 15), 1983-2003

Dependent Variable $\frac{\hat{P}_t^* - P_t}{P_t}$

Variable	**Coefficient**	**t-statistic**
Constant	0.00	-0.07
$\frac{\hat{P}_{t+1}^* - P_{t+1}}{P_t}$	0.93	20.94

$R^2 = .84$

F-Statistic = 438.28

Durbin-Watson 2.24

Table 2: Pairwise Granger-Sims Causality Tests

Variable	Null Hypothesis	F-Statistic
Interest Rate Spread	Interest Rate Spread does not cause change in land prices	4.26
	Land prices do not cause interest rate spread	7.78
Loan Credit Availability	Loan availability does not cause land price changes	4.55
	Land price changes do not cause loan availability	0.45
Corporate Liquidity	Corporate liquidity does not cause land price changes	4.38
	Land price changes do not cause corporate liquidity	4.72

Table 3A: Instrumental Variable Statistical Regression for Expected Land Price Forecast Model (Equation 16), 1982-2003

Dependent Variable $D(\text{Six Com})$, Change in Large City Commercial Land Prices

Variable	Coefficient*	t-statistic*
Constant	4.99	1.917
Interest Rate Spread, lagged $(\text{Bond Yield} - \text{Gen}(-1))$	-0.75	-0.46
Corporate Liquidity, lagged $(\text{Liquidity}(-1))$	0.67	2.59
Loan Availability, lagged $(\text{Loan}(-1))$	0.27	2.28

$R^2 = 0.51$

F - statistic =28.28

Durbin-Watson Statistic = 0.24

*White Hetroskedasticity-consistent variance and co-variance matrix

Table 3B: Present Value Model Statistical Results (Equation 15), 1982-2003

Dependent Variable $\frac{\hat{P}_t^* - P_t}{P_t}$

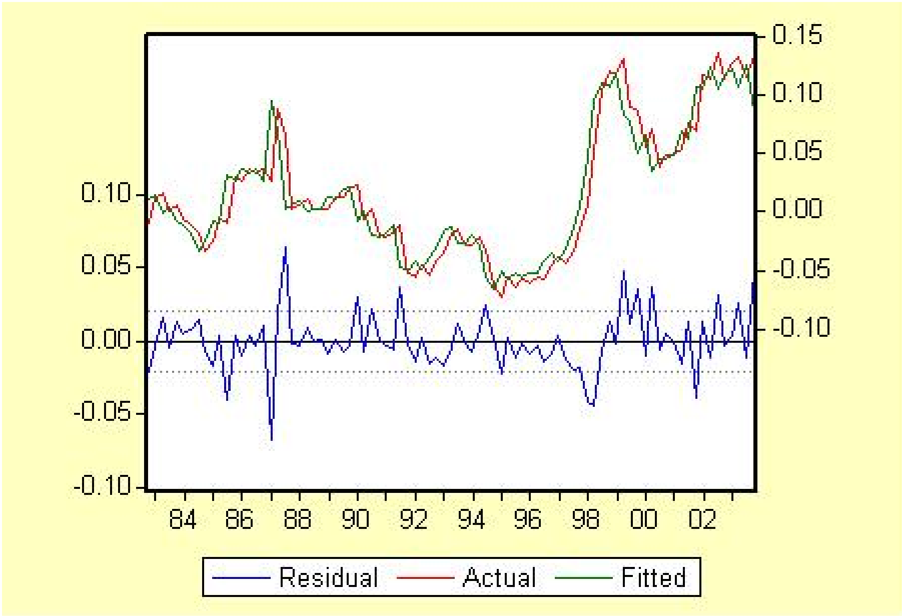
Variable	Coefficient	t-statistic
Constant	0.00	-0.37
$\frac{\hat{P}_{t+1}^* - P_{t+1}}{P_t}$	0.95	24.40

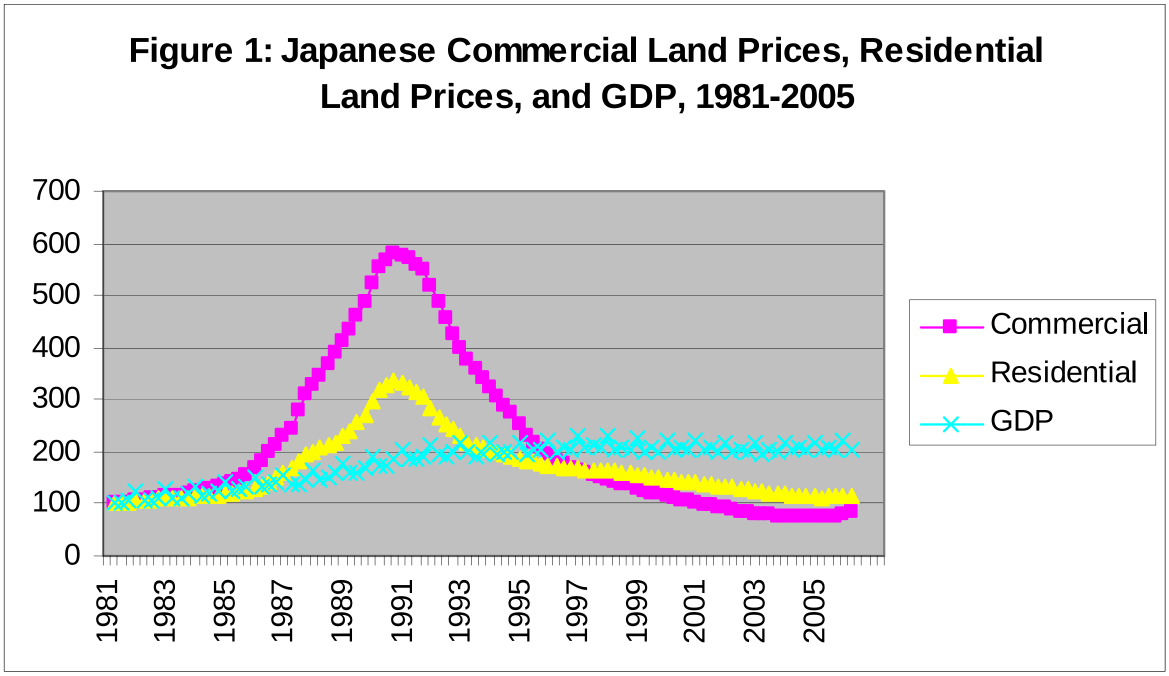
$R^2 = .80$

F-Statistic $= 595.38$

Durbin-Watson = 1.96

Figure 2: Statistical Fit for Expected Japanese Land Prices





Commercial = Commercial Land Price Index, Six Largest Cities (1983 = 100)

Residential = Residential Land Price Index, Six Largest Cities (1983 = 100)

GDP = GDP Index (1983 = 100)

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